Manaaki Whenua
Landcare Research

The Mana of Soil: A Māori Cultural Perspective of Soil Health in Aotearoa-NZ

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About the Soil Health Project

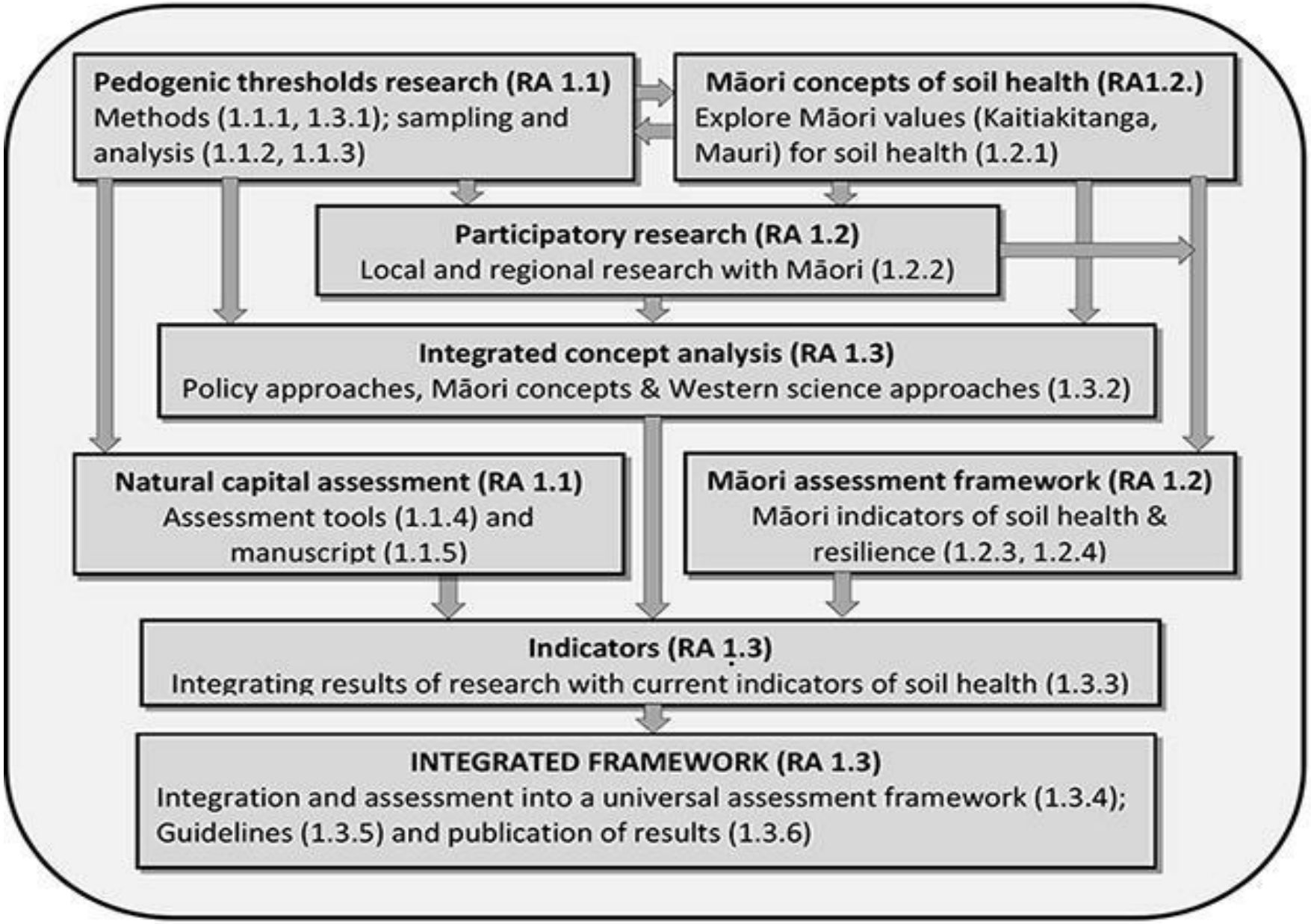
- **MBIE funded: Oct 2016-2021**
- **Soil health: oneone ora, tangata ora**
- **Full name: Soil ecosystem health and resilience – a pathway to prosperity and wellbeing**

Three Main Objectives:

I. Science excellence – Soil Resilience (testing pedogenic thresholds) – Science approach/large scale field sampling and lab analysis

II. Kaupapa Māori Research – Develop Māori Soil Health concepts, frameworks, indicators, and soil management

III. Integration, Management and Policy – Develop an Integrated Soil Health Framework


Pedogenic thresholds research (RA 1.1)
Methods (1.1.1, 1.3.1); sampling and analysis (1.1.2, 1.1.3)
Māori concepts of soil health (RA1.2.)
Explore Māori values (Kaitiakitanga, Mauri) for soil health (1.2.1)
Participatory research (RA 1.2)
Local and regional research with Māori (1.2.2)
Integrated concept analysis (RA 1.3)
Policy approaches, Māori concepts & Western science approaches (1.3.2)
Natural capital assessment (RA 1.1)
Assessment tools (1.1.4) and manuscript (1.1.5)
Māori assessment framework (RA 1.2)
Māori indicators of soil health & resilience (1.2.3, 1.2.4)
Indicators (RA 1.3)
Integrating results of research with current indicators of soil health (1.3.3)
INTEGRATED FRAMEWORK (RA 1.3)
Integration and assessment into a universal assessment framework (1.3.4); Guidelines (1.3.5) and publication of results (1.3.6)

Developing a longer term view of soil health

- Soil quality/health generally defined by dynamic soil characteristics (such as pH and soil nutrients) – largely inadequate to assess long-term changes to soil health and resilience.

- Currently soil resilience is poorly defined

- **Need to understand and explore the meaning of soil health from a kaupapa Māori perspective e.g. Māori values, principles, use inter-generational concepts of guardianship of land/whenua (e.g. kaitiakitanga, mana, mauri)**

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I. General (science based) soil health concepts and definitions

The terms “soil quality” and “soil health” are often used interchangeably by the popular press and in scientific literature (Allan et al. 1995). Doran and Zeiss (2000) summarise the concept of soil health/ quality as the

“…capacity of a soil to function as a living system to sustain biological productivity, promote environmental quality and maintain plant and animal health”.

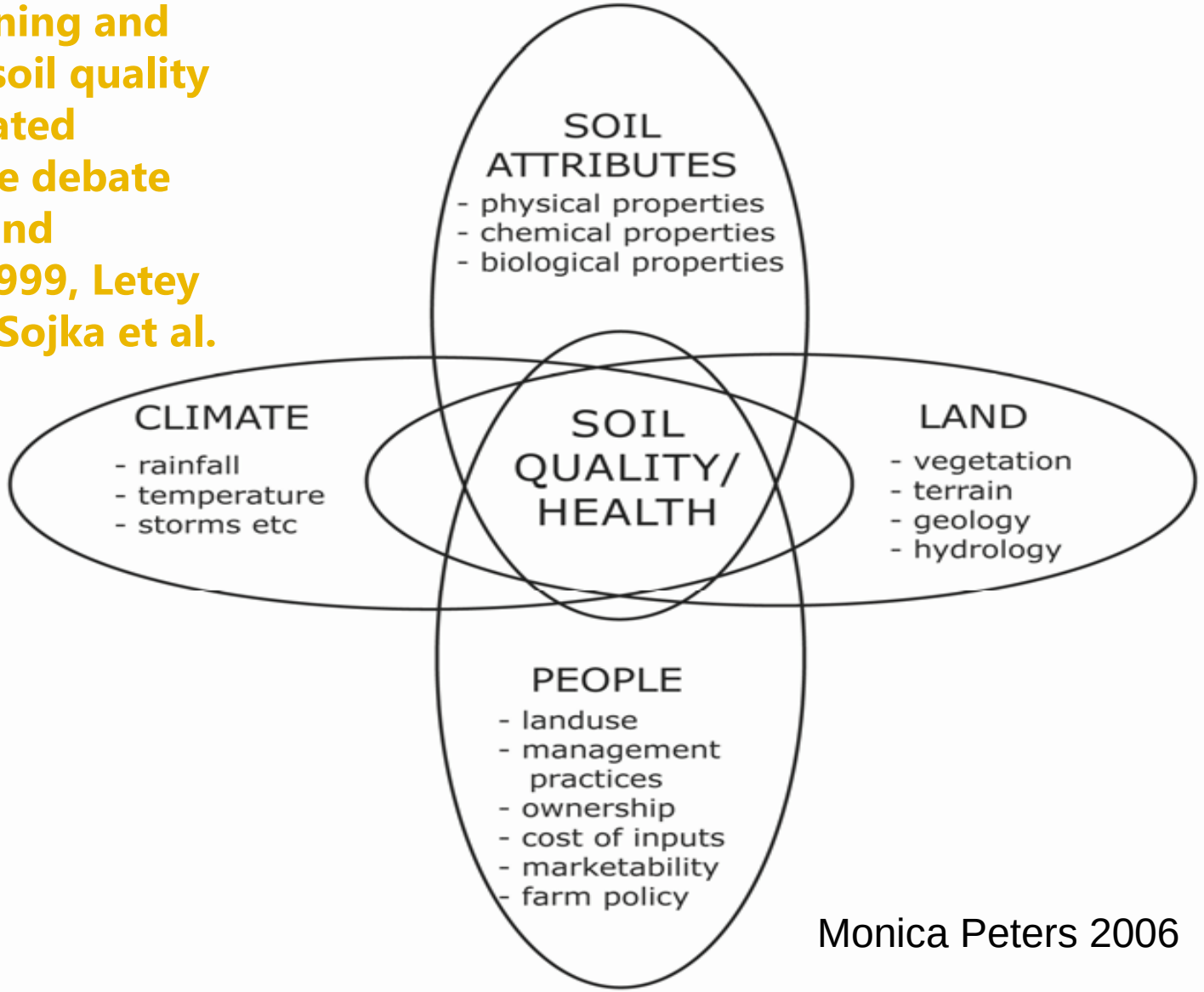
This broad definition encompasses such themes as soil fertility, potential productivity, resource sustainability and environmental quality (Singer and Ewing 2000).

Defining whether a soil is of high or low quality, healthy or unhealthy, good or bad quality also rests on the perceived suitability of the soil for its intended end use, function or purpose (Sparling and Schipper 1998).

A further consideration is the degree of modification a soil requires in order for it to be suited to its intended use (Cornforth 1998:209), and thus encompasses the notion of fitness for future use.

(Monica Peters 2006 Māori farmers perspectives and experience of pasture soil health: indicators, understandings and monitoring methodology. Master of Science thesis, Otago University, Dunedin, New Zealand).

The multifaceted nature of soils, and the task of defining and measuring soil quality have generated considerable debate (see Sojka and Upchurch 1999, Letey et al. 2003; Sojka et al. 2003).



Monica Peters 2006

Other definitions

Soil health is **"the continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals and humans"** (Natural Resources Conservation Service – USDA-NRCS, 20122; Soil Renaissance, 2014).

Doran and Parkin, in 1994, defined soil quality as **"the capacity of a soil to function, within ecosystem and land use boundaries, to sustain productivity, maintain environmental quality, and promote plant and animal health."** (Cornell Assessment of Soil Health (2012)

(source: Bryan Stevenson)

Soil Health or Soil Quality?

- The term ‘soil health’ has been generally preferred by farmers, while scientists have generally preferred ‘soil quality’.

- **Dynamic soil quality, is equivalent to soil health, and refers to soil properties that change as “a result of soil use and management over the human time scale”.**

- **Soil health invokes the idea that soil is an ecosystem full of life that needs to be carefully managed to regain and maintain our soil’s ability to function optimally**

- In general, soil health and soil quality are considered synonymously and can be used interchangeably, with one key distinction conceptualized by scientists and practitioners over the last few decades:

- Soil quality includes both inherent and dynamic quality. Inherent soil quality refers to the aspects of soil quality relating to a soil’s natural composition and properties (soil type, as delineated by the USDA NRCS Soil Survey) influenced by the natural long-term factors and processes of soil formation.

Soil Health Indicators

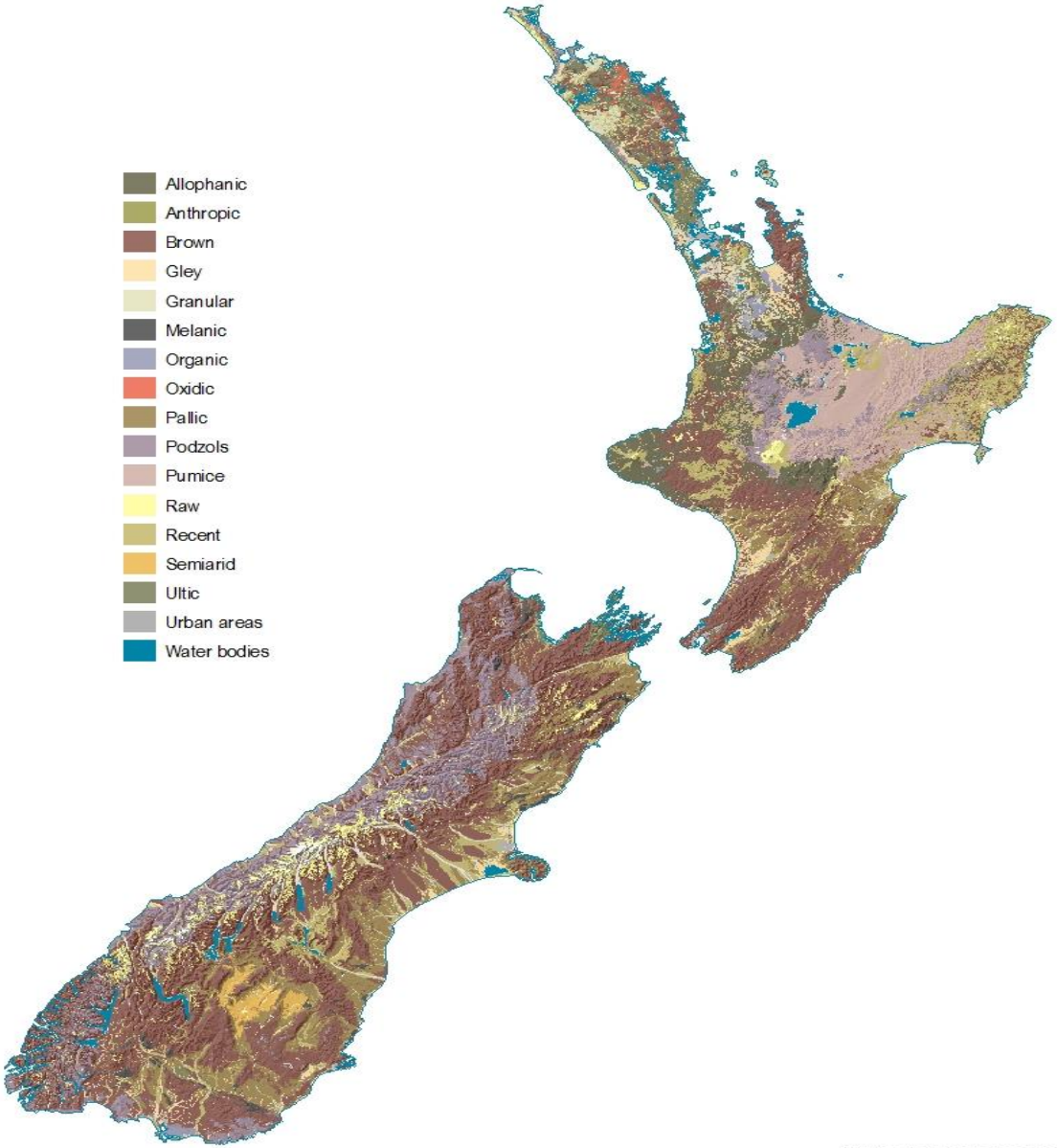
Soil health indicators were classified into four types (Mackay et al. 2013):

- acidity (measured by soil pH)
- organic reserves (measured by total carbon, total nitrogen, and mineralisable nitrogen)
- fertility (measured by Olsen phosphorus)
- physical status (measured by bulk density and macroporosity).

NZ SOIL HEALTH MEASURES TO DETERMINE SOIL HEALTH INDICATORS

Soil health indicators	Soil measures	Why is this measure important?
Organic reserves	Total carbon	Organic matter helps soil retain moisture and nutrients, and supports good soil structure
	Total nitrogen	Reserves of nitrogen are stored within organic matter in the soil
	Mineralisable nitrogen	Mineralisable nitrogen is a form of nitrogen that plants can use for growth and is an indication of soil organism activity and health
Fertility	Olsen phosphorus	Plants get phosphorus from phosphates in the soil, but many New Zealand soils have naturally low available levels
Acidity	pH	Soil pH controls the activity of nutrients and metals in soil. Most plants have an optimal pH range for growth
Physical status	Bulk density	Soils with high bulk density drain poorly and restrict plant root growth, while soils with low bulk density are vulnerable to erosion
	Macroporosity	Large pores allow air and water to penetrate into soil for root growth and soil biological activity, but these are easily compacted

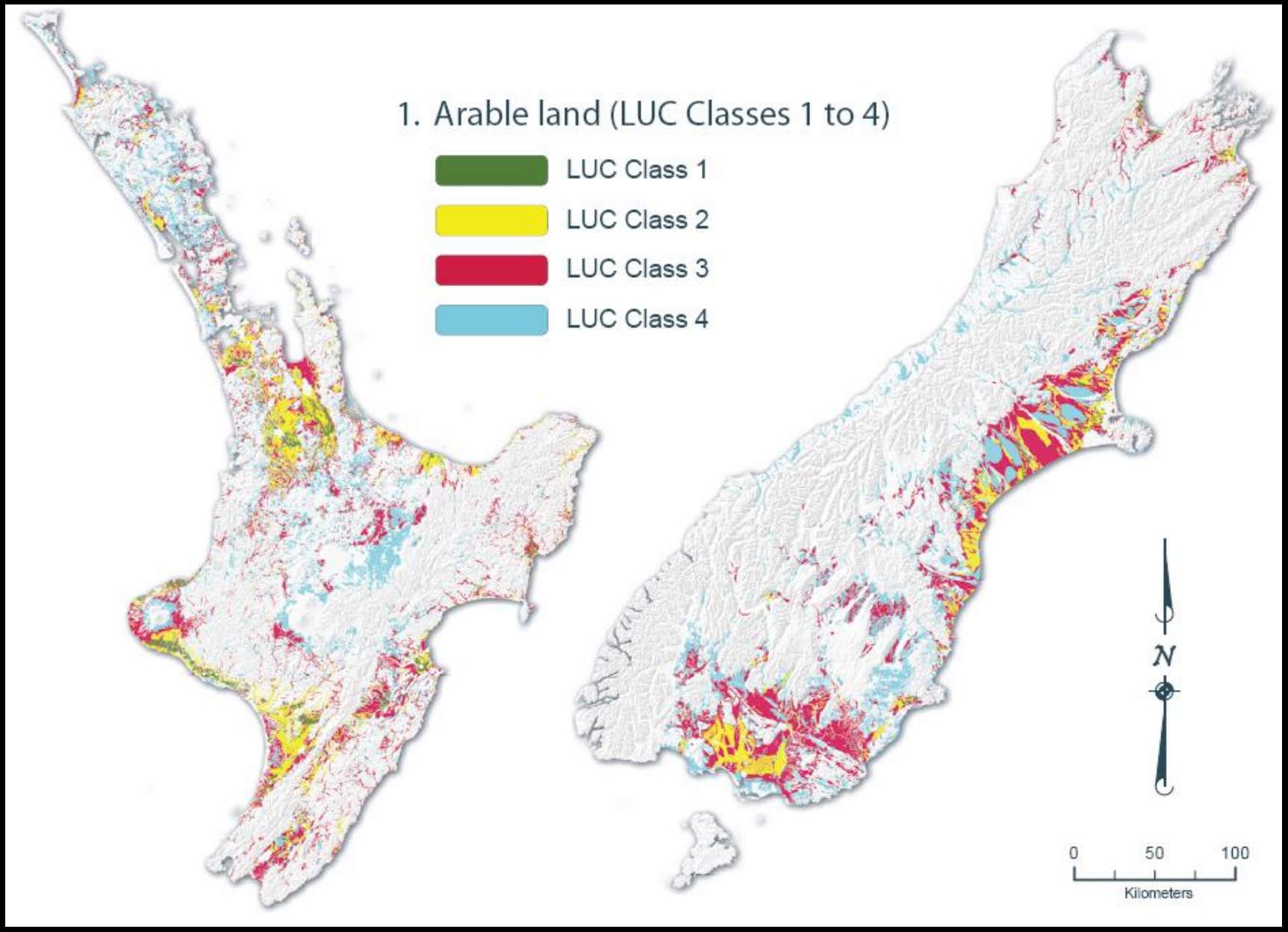
Soil orders

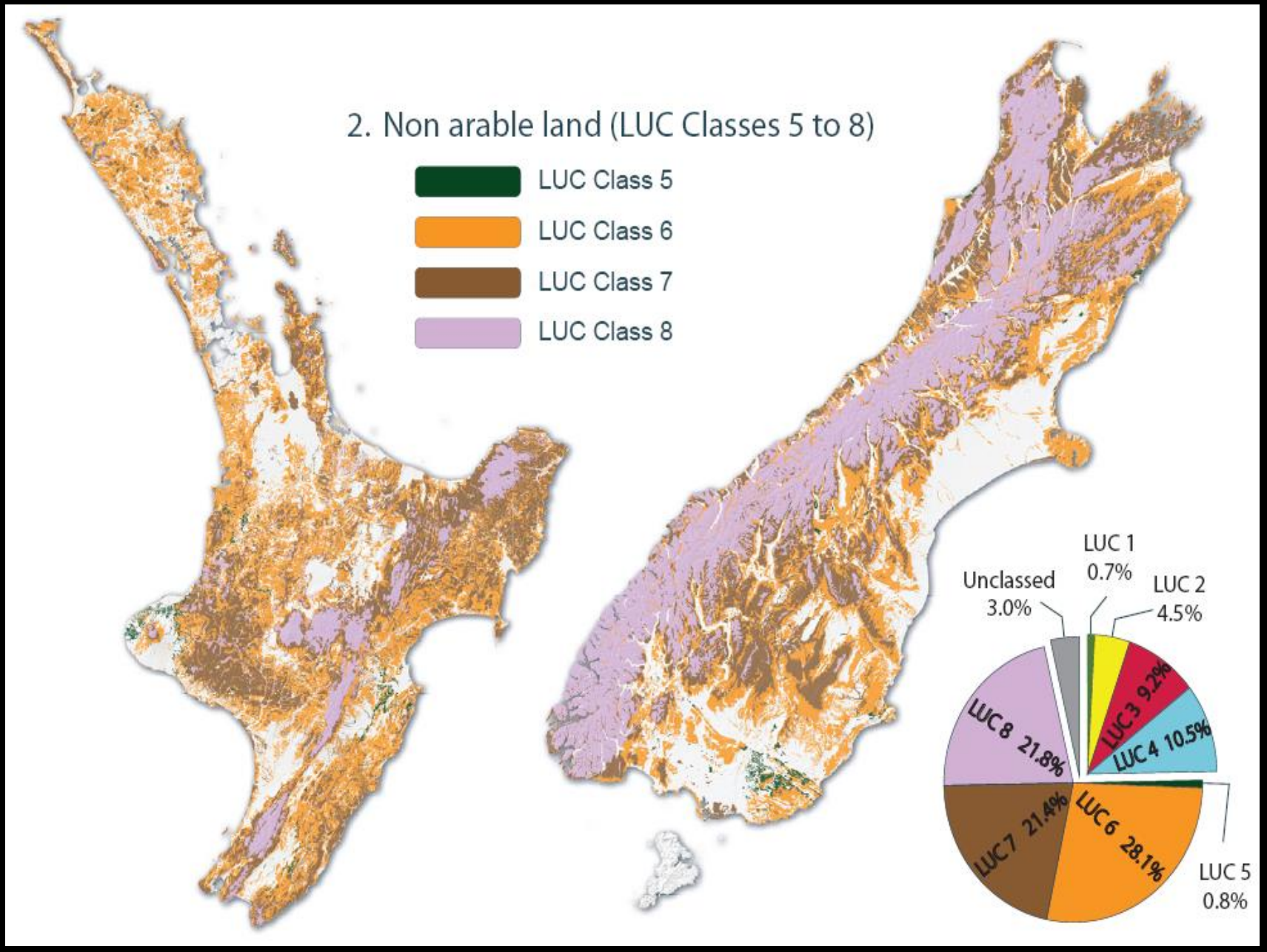


Source: Landcare Research

NZ Soil Classification Names

Soil order	Area of NZ (ha)	% of NZ
Allophanic	1,367,388	5
Anthropic	6236	<1
Brown	10,894,877	43
Gley	711,832	3
Granular	292,787	1
Melanic	322,209	1
Organic	255,681	1
Oxidic	44,090	<1
Pallic	3,090,990	12
Podzol	3,287, 043	13
Pumice	1,721,087	7
Raw	709,224	3
Recent	1,401,703	6
Semi-Arid	222,278	1
Ultic	761,716	3
New Zealand	~26 million ha	100


1. Arable land (LUC Classes 1 to 4)
LUC Class 1
LUC Class 2
LUC Class 3
LUC Class 4
N
0
50
100
Kilometers


2. Non arable land (LUC Classes 5 to 8)
LUC Class 5
LUC Class 6
LUC Class 7
LUC Class 8
LUC 1
0.7%
Unclassed
3.0%
LUC 2
4.5%
LUC 3 9.2%
LUC 4 10.5%
LUC 8 21.8%
LUC 7 21.4%
LUC 6 28.1%
LUC 5
0.8%

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II. Kaupapa Māori Research Objectives

- Define Soil Health concepts and knowledge from a Māori perspective
- Local, Regional and National level Māori coordination and research
- Development of a Māori soil health framework and indicators
- Integration of key concepts and knowledge into a national assessment framework

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Kaupapa Māori

Present measures and indicators of soil health in Aotearoa-New Zealand do not recognise cultural perspectives or incorporate other knowledge systems, such as mātauranga Māori

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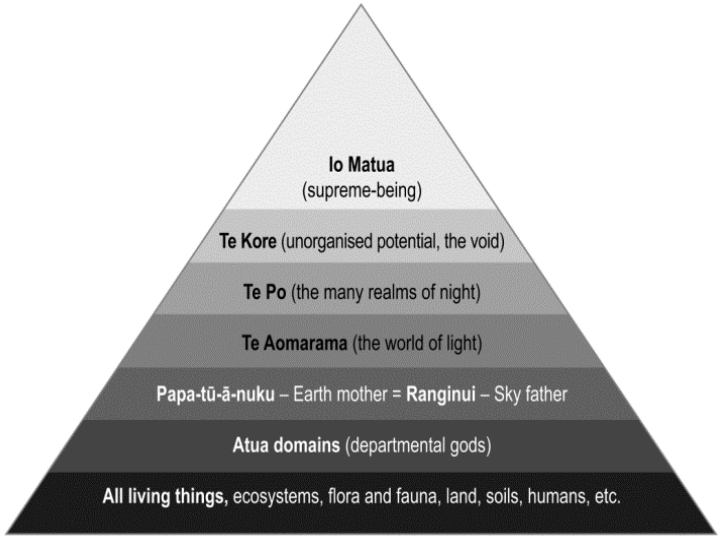
III. Māori beliefs, mātauranga Māori (traditional knowledge) go back to early teachings

Concepts of Health and Kaitiakitanga

Understanding Māori beliefs, knowledge, perspectives, and concepts



TWO PRIMEVAL PARENTS	
Papa-tū-ā-nuku – Earth mother = Ranginui – Sky father	
DEPARTMENTAL ATUA (CHILDREN)	
Tangaroa	The god of oceans, seas, rivers, lakes, and all life within them (and reptiles, fish, amphibians) & Tū-te-wehiwehi (grandson of Tangaroa and also referred to as the father of reptiles, lakes, rivers, freshwater)
Tāne-mahuta	The god of the forests and all living things within them
Tāwhiri-mātea	The god of winds and storms
Rongo-mā-Tāne	The god of cultivated foods (e.g., kūmara-sweet potato), also god of peace
Haumia-tiketike	The god of fern roots and other wild foods
Rūaumoko	The god of earthquakes and volcanoes
Tū-mata-uenga	The god of man and war
Whiro	The god of evil, the domain of darkness and death

Ngā Atua domains framework

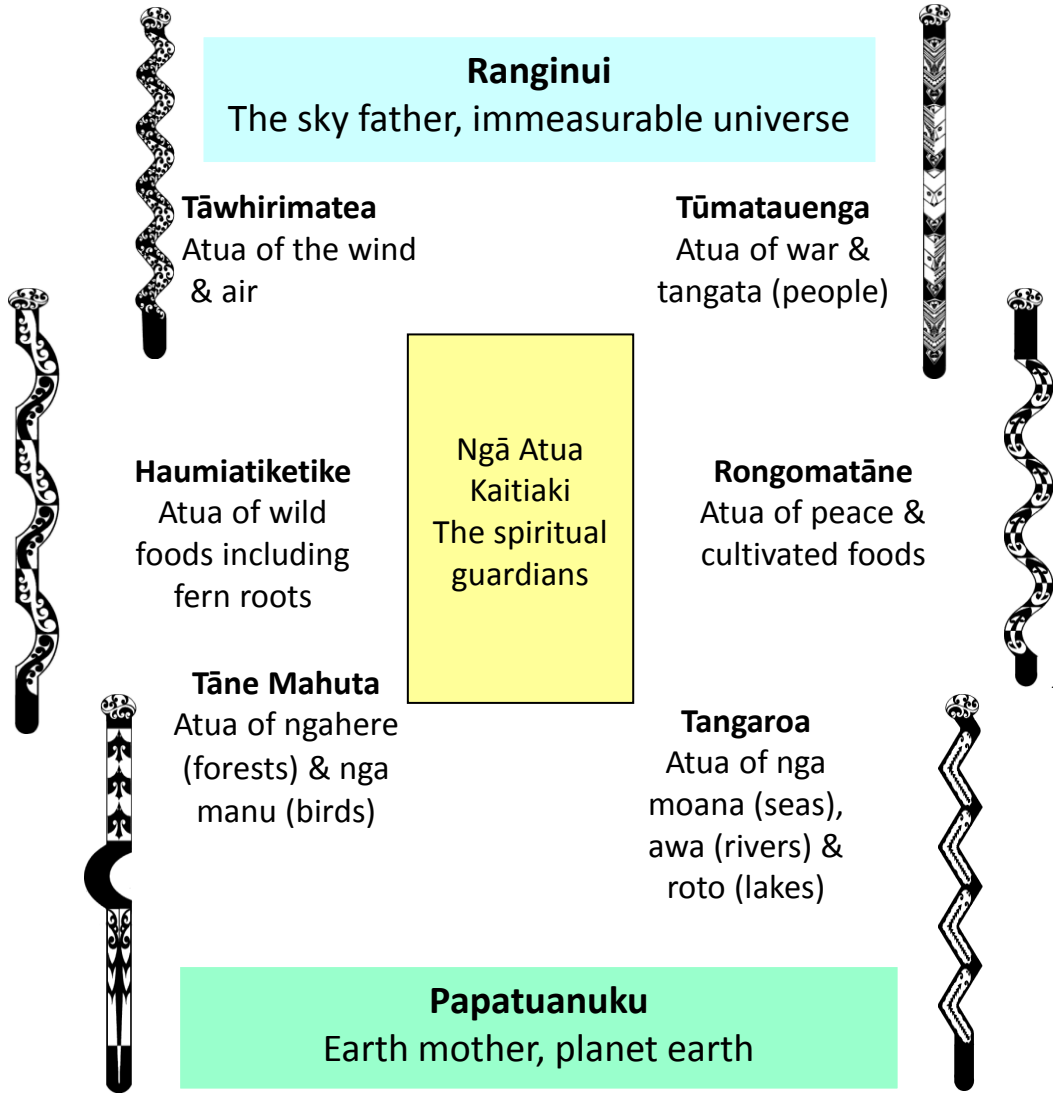


Figure 1: Atua (departmental gods) domain framework
Source: Tiakina te Taiao.

E kī ana ā tātau nei kōrero, ko Tiki te tangata tuatahi, ko Hine-ahu-one te wahine tuatahi i pokepoketia ki te one i Kurawaka (TTT 1/8/1925:275).

Narratives state that Tiki was the first man and that Hine-ahu-one, the first woman, shaped with earth at Kurawaka. (Te Māhuri Study Guide (Ed. 1): 48-51;)

Ko tō rātou haerenga ki te ahu i te puehu o te one i Kurawaka. Koia a Hine-ahu-one, arā a Hine-hau-one, te wahine tuatahi (TTT 1/6/1924:63).

They went to fashion her from the dust of the earth at Kurawaka. Thus was Hine-ahu-one, Hine-hau-one, the first woman. (Moorfield 2003, 2004).

Traditional, local, and contemporary knowledge

Tribal stories (pūrākau)

TE TAENGA MAI O TAKITIMU KI AOTEA-ROA NEI.
“Pewhea ake te tua-whenua?” Ka mea atu a Nga-Toro', “He pai; he one tai etahi wahi, he one matua etahi wahi, he one tuatara, he paraumu, he one-rere, he one-punga, he one-haruru, he one-puia, he one-kirikiri, he one-powhatu, he one-takataka, etahi wahi.”

“What kind of land is this?” Ngātoroirangi replied:
“It is good. Some parts are limestone, some are sandy soil, others rich soil, others friable soil, black soil, sand, pumiceous soil, and light sandy soil, red volcanic soil, some parts are gravelly, stony, and some are very loose soils” (JPS 1915).

On arrival at Patea Turi decided to make it his permanent home, having satisfied himself by the sense of smell of the fertility of the soil; hence the proverb common to this day:

“Te oneone i hongia e Turi.”

The soil which Turi smelled.

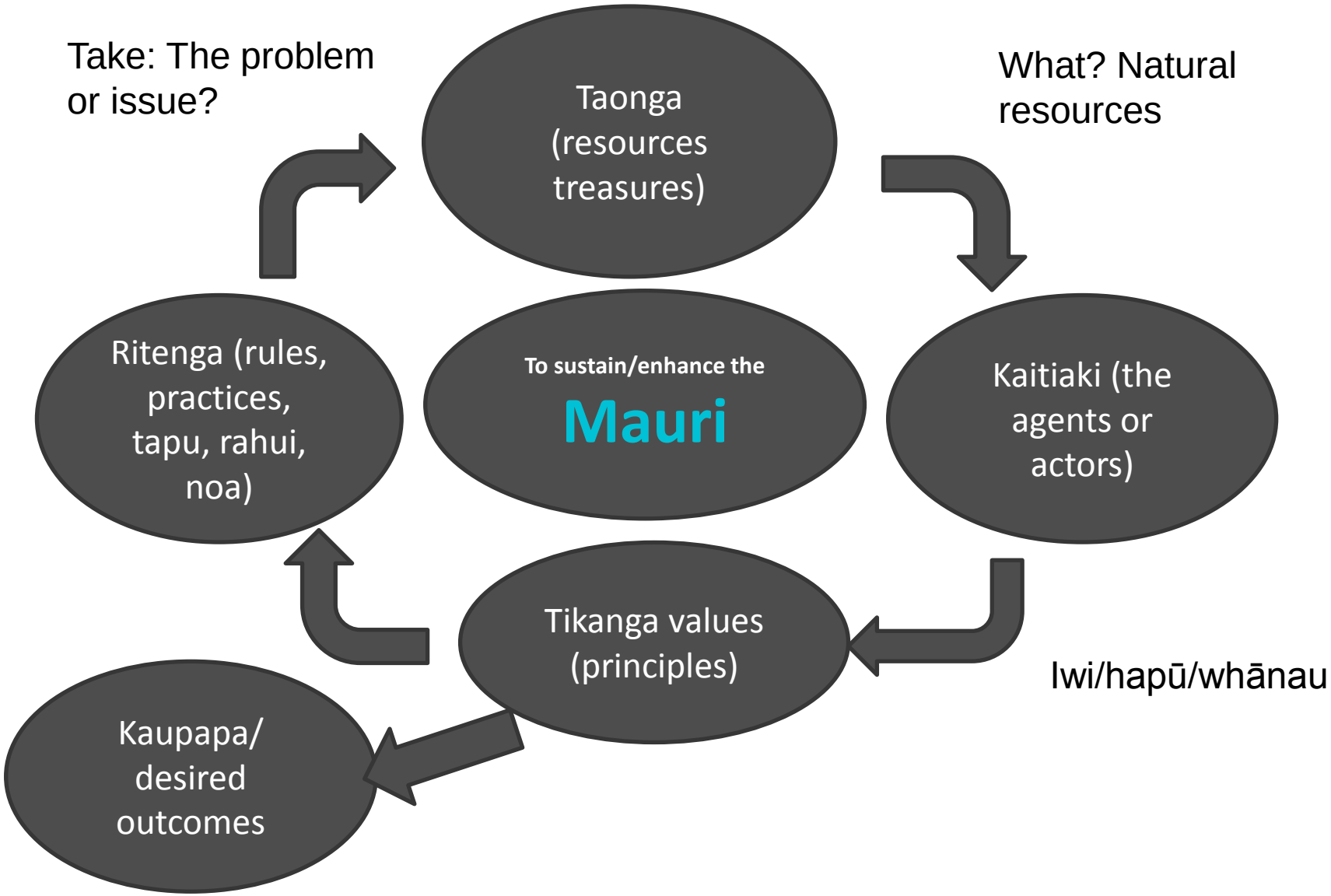
JPS 1901 Vol 10:

Māori gardeners had at least 60 names for types of soil

Maori names for soils	Maori names for soils
One-pū – sand One nui – rich soil, consisting of clay, sand and decayed organic material One-matua – typically loam One mata – dark fertile soil Tuatara wawata – brown friable fertile soil suitable for kūmara One-pārakiwai – silt One paraumu – very dark fertile soil, friable One hanahana – Dark soil mixed with gravel or small stones One haruru – Light but good soil; sand and loam	One hunga – sea sand, sandy beach, sometimes mixed with mud One kopuru – soil found in wet situations One kōkopu – gravel, or very gravelly soil One kura – reddish, poor soil One pākirikiri – soil containing gravel One parahuhu – alluvium (also parahua) One punga – light spongy soil One tai – sandy soil, near tidal flats, near beach One tea – white soil, sandy volcanic material One takataka – friable soil One tuatara – stiff brown soil, needing sand or gravel worked in

Maori names for soils	Maori names for soils
Kere was used as a prefix for some types of clay, including: keretū, kerematua and kerewhenua: Keretū - clay Kerematua – stiff clay Kerewhenua – yellow clay Kereone – sandy earth, e.g., near Morrinsville One wawata – lumpy soil Kirikiri tuatara – fertile brown soil	Kōtae – alluvial soil One tea – light sandy soil, near Dargaville. Kenepuru – sandy silt Kōtore – white clay Taioma – pipe clay Uku - unctous clay, white or bluish Uku whenua – plastic clay (old traditional name – **KUPE AND NGAKE START FOR NEW ZEALAND JPS 1913.** Matapaia – a clay when baked hard was used as a stone for cooking

Te Ao Māori conceptual framework (source: Hirini Matunga)



IV. Māori wellbeing and health

"Māori consider the environment fundamental to their well-being as their cultural values and the environment are inextricably linked. Finding a balance between the physical, spiritual, mental, and family dimensions of individuals was stated as the key to ensure optimum well-being".

- A Te Ao Māori Health Focus
- *In the late 20th century many Māori believed the non-Māori health focus was too narrow and singular (i.e. concentrated too much on just physical illness) to meet their needs and did not reflect their traditional knowledge systems and values, and their holistic understanding of health and wellbeing.*

- **A number of kaupapa based holistic Māori conceptual health models have been developed.**

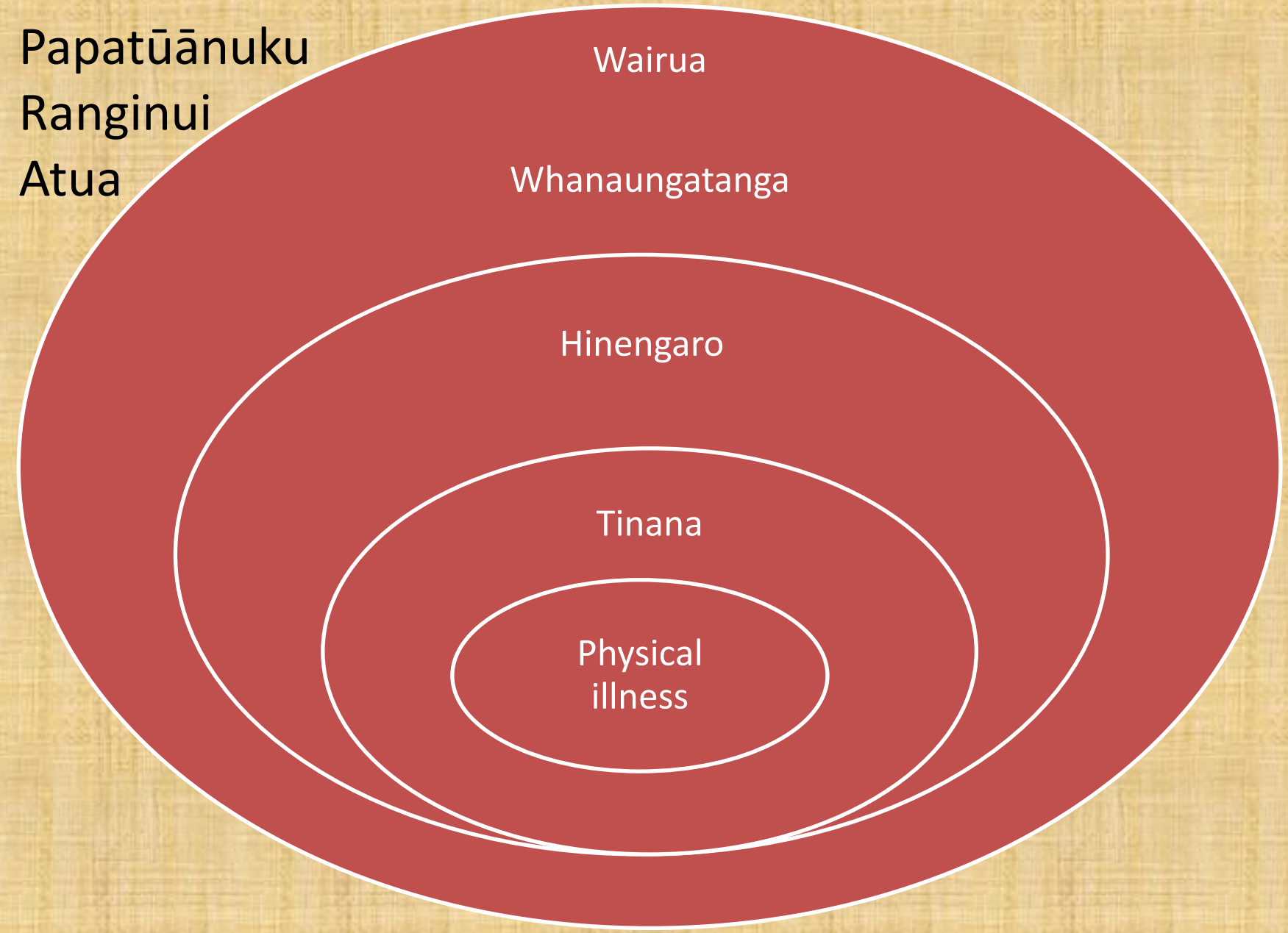
Kaupapa based Māori health models

Models used to conceptualise the components of Māori well-being commonly emphasise the interactions and balance through 4 dimensions of reality:

- *taha tinana* – a material state or dimension, the body
- *taha hinengaro* – a mental state or dimension
- *taha wairua* – a spiritual state or dimension
- *taha whānaugatanga* – family, a related or associative state or dimension.

There are many variations of these models and concepts, but most stress a set of principles and practices to achieve a goal of mauri maintenance and human well-being (Durie 1994).

Papatūānuku
Ranginui
Atua



Three common Māori well-being models (Durie 1994)

	Whare Tapa Wha	Te Wheke	Ngā Pou Mana
Components	Taha Wairua Taha Hinengaro Taha Tinana Taha Whānau	Wairuatanga Hinengaro Tinana Whanaungatanga Mana ake Mauri Hā a koro mā a kui mā Whatumanawa	Whānaungatanga Taonga tuku iho Te Ao tūroa Turangawaewae
Features	Spirituality Mental health Physical Family	Spirituality Mental health Physical Family Uniqueness Vitality Cultural heritage Emotions	Family Cultural heritage Environment Land base
Symbolism	A strong house	The octopus	Supporting structures

V. Collaborative research – with who?

- Māori researchers, Universities, CRIs, experts
- Jessica Hutchings, Te Waka Kai Ora (Māori organics collective, Hua Parakore)
- Antoine Coffin, Te Onewa consultants
- Tumu Paeroa (largest Māori land manager in NZ)
- Māori land owners
- Iwi/Hapū/Kaitiaki groups, elders (e.g., Te Taitokerau, Rangitāne, Te Arawa, BOP-Tauranga, Waikato-Maniapoto, Taranaki, Te Waipounamu)
- Te Wharekura o Maniapoto (Rangatahi)
- Māori businesses/industry groups
- Interviews, groups, hui/wānanga, field-days, surveys, etc.

National Maori Organic Authority
Guardians of Hua Parakore

Hua Parakore – An Indigenous verification and validation system for food and product.

Hua Parakore

- **Whakapapa, mana, mauri and wairua is at the heart of Hua Parakore.**
- "Knowing about where the seed comes from so that it has some integrity in ensuring that they are safe seeds and that they're easily dependable and you know that the seeds are going to grow again….its about integrity and dependability in terms of sustainability (Te Waka Kai Ora 2011b, p13; Hutchings et al. 2012)"
- **Ma te Hua Parakore e kaitiaki te ora te pae o Papa-tū-ā-nuku, te ora ngā hua me ngā rākau katoa o Tāne, otirā , me te ora o te tinana o ngā tāngata katoa**
- **Hua Parakore maintains healthy soils, healthy plants and healthy people (Te Waka Kai Ora 2011b, p22; Hutchings et al. 2012)**

Hua Parakore guiding values and principles

- **NGĀ TIKANGA O WAIRUA** (spiritual, peace, safety) *Ko te Hua Parakore te Kaitiakitanga o te humariretanga me te ora*

- **NGĀ TIKANGA O MANA** (authority, justice) *Ko te Hua Parakore te waka mo te pono me te tika*

- **NGĀ TIKANGA O MĀRAMATANGA** (enlightenment) *Ko te Hua Parakore te huarahi o te maramatanga mai tawhiti*

- **NGĀ TIKANGA O TE AO TŪROA** (natural order, sustainability, kaitiakitanga) *Ma te Hua Parakore e Kaitiaki i nga Tikanga tuku iho o te Maara*

- **NGĀ TIKANGA O MAURI** (healthy soils, healthy plants, healthy people) *Ma te Hua Parakore e kaitiaki te ora o te pae o Papatuanuku, te ora o nga hua me nga rakau katoa o Tane, otira, me te ora o te tinana o nga tangata katoa*

Hua Parakore

- **It is particularly important to enhance the mauri of the soil by enhancing its fertility, structure and biological activity (Te Waka Kai Ora 2011b, p22)**

- This places a focus and responsibility on maintaining the mauri or life energy/vitality of the soil, to ensure human wellbeing. It is particularly important to enhance the mauri of the soil by enhancing its fertility, structure and biological activity (Te Waka Kai Ora 2011b, p22)

- Hutchings, J., Tipene, P., Carney, C., Greensill, A., Skelton, P., & Baker, M. (2012). Hua Parakore, an Indigenous food sovereignty initiative and hallmark of excellence for food and product production. MAI Journal, 1(2): 131–145.
- Te Waka Kai Ora 2011b. Nga kaupapa o Hua Parakore. Wellington: Te Waka Kai Ora.

Te Wharekura o Maniapoto

In order to gain a Māori perspective on soil health, it was important to seek a perspective from rangatahi Māori (Māori youth). Soils wānanga were conducted with the mātaamua tauira (senior students) of Te Wharekura o Maniapoto.

Mātaamua Tauira

- A Rangatahi (Māori youth) perspective
- Curriculum learning – soil
  - Māra kai
  - Pātaka
  - Fertilizers
  - Pesticides
- Onsite nursery – riperian planting
- Lots of practical experience
- Knowledge of Soil Health

First Session

- Work in 3 groups
- 3 patai

1. How important are soils to you?
2. How can you measure soil health?
3. What tohu do you measure the health of soil?

How important are soils to you?

- Tangata Whenua
- 0% (kore) – 100% (hundy)
- For the people to stand on
- Healthy soil = FOOD, Unhealthy soil = NO FOOD!!!

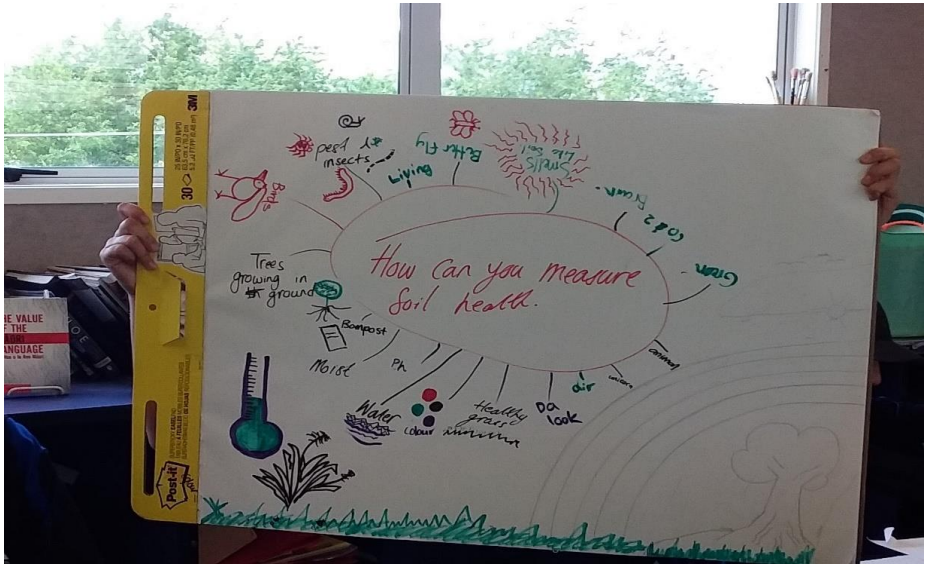
- Soils clean the water, soils feed the plants

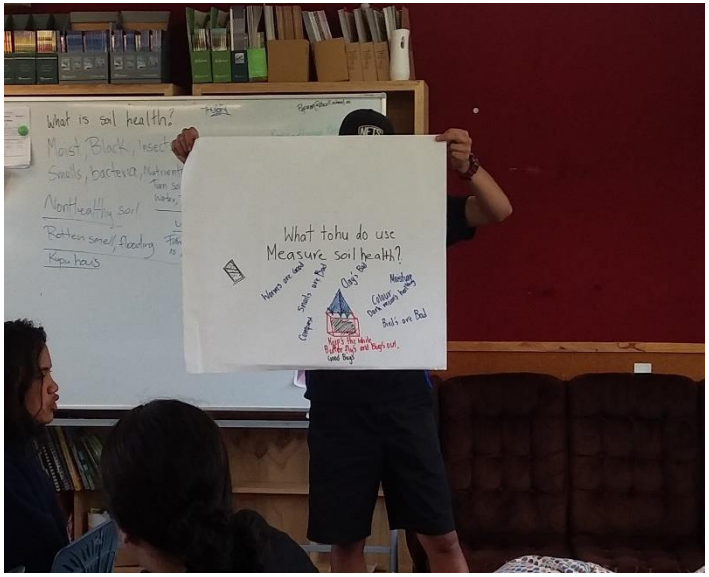
- We live off it, on it, We fought for it, live for it, with it – we would be dead without it!!!

How do you measure soil health?

- Trees growing in the ground
- Smells like soil
- Healthy plants
- Insects and worms
- nutrients

- Worms are good
- Snails are bad
- Dark colour means healthy
- Compost
- Moisture
- Good health





Māra kai and Nursery

- Involved in the development of the nursery
- Very confident in the māra and nursery surroundings
- Whakaaro started to appear
- Entrepreneurship
- Responsibilities
- Ownership

RUIA NGA PURAPURA

Sowing the seeds

Antoine Coffin

A community research project

Conducted by:

TE ONEWA CONSULTANTS

In association with:

Manaaki Whenua Landcare Research

Funded by:

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

This research project investigates the link between traditional Māori gardening and soil heath using anthropological and Mātauranga Māori perspectives for the purpose of identifying potential soil ecosystem health and resilience characteristics.

Kaupapa - purpose

Explore the term soil health and resilience from a ‘Kaupapa Māori’ – mātauranga Māori/Māori values based – perspective using Māori knowledge frameworks, concepts, and terms, that can be used to define soil ecosystem health characteristics, pressure-state and impact indicators, and describe soil resilience characteristics from a Māori lens. We will use this information to develop soil assessment methodologies for Māori, especially to support kaitiakitanga and Māori agribusiness to achieve desired outcomes

What does this mean?...

Te Takiwa o Te Wairoa

He aha te mahi?

A local community research project (Tauranga)to identify:

- Characteristics of soil from an hapu perspective
- Traditional soil systems and cultivation techniques
- Potential themes and specific tikanga
- A potential set of relevant iwi/hapū Māori soil health indicators

Te Pura (gardens)

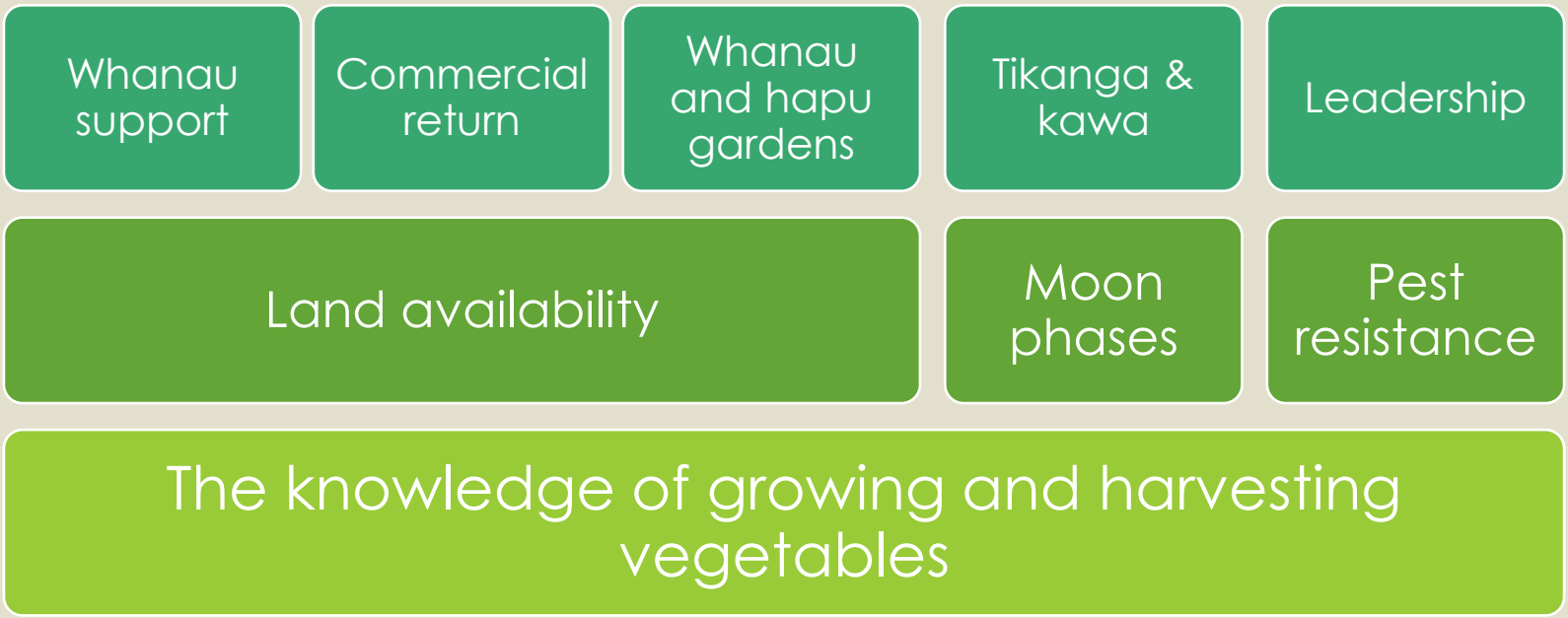
1886
- Kūmara
- Potatoes
- Maize
- Wheat
- Pumpkin

1935
- Kumara
- Rīwai
- Kamokamo
- Kanga
- Pumpkin
- Onions
- Watermelon

1980
- Kumara
- Rīwai
- Watermelon

2017
- Kumara
- Rīwai

Ngā Mōhiotanga o ngā mahi māra



Hua parakore indicators and measures

Hua parakore mauri maintenance/enhancement	Hua parakore verification indicators	Measures? (examples) Recording and monitoring
Cultural	Mauri/assess/monitor mauri	Kaupapa Maori /Hua parakore mauri assessment and indicators Use of kaitiaki
	Mahinga kai	Assessment e.g. Wai Ora Wai Maori, CHI Use of kaitiaki Monitor water passing through mahinga kai Effluent management Nutrient budgets Cultivation practices Mitigate Stock access to streams (assess/manage)
	Maintain and enhance diversity of mahinga kai (increase biodiversity)	Companion planting Biological control of pests Diverse seed stock Cultivation practices
	Healthy soils	Soil fertility testing Monitor composting practices Use of livestock/monitor
	Detailing cultural practices	Recording and monitoring: e.g. number recorded /protected Wāhi tapu sites Wāhi taonga Wāhi tupuna (pā, papakāinga) Mahinga kai
Environmental	Environmental indicators	Soil and water testing

Key soil quality indicators (SI Māori farmers) (Peters 2006)

INDICATOR CATEGORIES	INDICATORS of "Good quality soil"
Physical characteristics	- Soil colour - Drainage and infiltration - Soil smell, feel, texture and weight - Constituents of topsoil and subsoil - Level of / resistance to compaction and pugging - Level of / resistance to erosion - Slope and aspect
Biological characteristics	- Presence of desirable invertebrates - Rate of organic decomposition
Chemical characteristics	- Soil fertility - pH and levels of other primary nutrients
Cover crop	- Pasture recovery times; pasture growth rates - Pasture composition - Pasture colour; sward thickness - Rooting depth - Species and quantity of weeds present
Stock	- Stock movement - Stock condition and overall production levels

Performance based measures

Peters, M. 2006. Māori farmers perspectives and experience of pasture soil health: indicators, understandings and monitoring methodology.
Master of Science thesis, Otago University, Dunedin, New Zealand.

Tumu Paeroa
Key indicators and measures of soil health

Indicator categories	Indicators of soil health	Measures
Physical characteristics	Bulk density/compaction (dry bulk density) Porosity Rooting depth Available water	Grams per cubic centimetre Milligrams per cubic metre g/cm^3 or Mg/m^3 Most topsoils between 0.9-1.2g cm^3, compact subsoil~1.6g cm3, sands ~0.6-0.7, loams ~0.6-0.7.
Biological characteristics	Earthworms Soil organisms	Type/Abundance/Density
Chemical characteristics	Organic matter Total carbon (C) content - Soil fertility - pH and levels of other primary nutrients	Soils typically ~1-10% organic matter C 150 tonnes/top 1m/ha % total C. 1.7=% soil organic matter
Cultural	Cultural sites	Wāhi tapu sites Wāhi taonga Wāhi tupuna (pā, papakāinga) Mahinga kai e.g. number recorded /protected

Performance based measures (ARGOS - NZ Sustainability Dashboard) Reid, J. Barr, T., Lambert, S. 2013.

Mauri-water	Mauri-Land	Mauri-community	Mauri-Air
Measures			
Stream health **Aquifer** **Irrigation** **Contamination** **Etc.,**	Soil health Biodiversity	Living wage Employment conditions Community involvement Etc.,	GHG Etc.,

Reid, J. Barr, T., Lambert, S. 2013. Indigenous Sustainability Indicators for Māori farming and Fishing Enterprises.
A Theoretical Framework Ngai Tahu Research Centre, University of Canterbury.
The NZ Sustainability Dashboard Research Report 13/06 (edited by Dr Golda Varona).
Published by ARGOS. 42p. Retrieved from www.nzdashboard.org.nz.

Indigenous sustainability indicators (ARGOS - NZ Sustainability Dashboard) – Key performance indicators

KPIs based on customary knowledge	KPIs based on Empirical Science
• **Personal assessment of the overall health/state of a site based upon experience.** • **Levels of modification/change observed at a site.** • **Suitability of the site for harvesting mahinga kai.** • **Access issues in relation to the site.** • **Amount of pressure from external factors.** • **Presence, absence, abundance and diversity counts for taonga (valued) bird, plant, and fish species as well as pest and weed species.** • **Willingness to return to the site for harvesting mahinga kai.**	• Application of Stream Health Monitoring and Assessment (SHMAK) • Water quality test for the levels of nitrates and the presence of Ecoli, including levels of anti-biotic resistance. • GIS mapping of the results for ease of understanding.

Manaaki Whenua
Landcare Research

VI. Māori Soil Health Concepts, definitions, frameworks

(conclusions, findings to date)

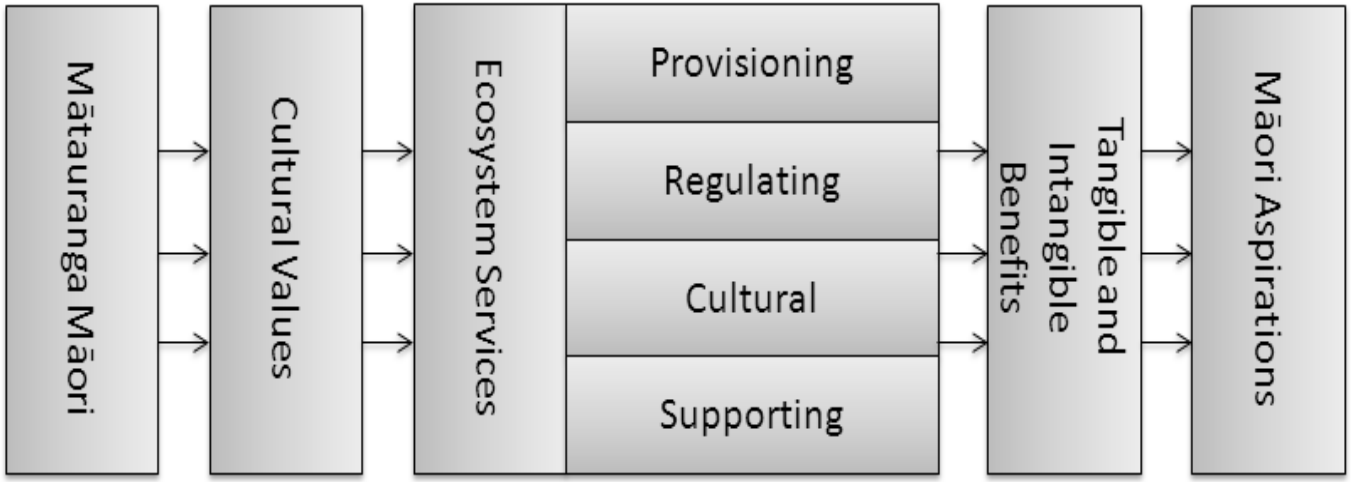
Finding balance in the system – the principle of mauri

"Traditionally Māori acknowledged a natural order to the universe, a dynamic system built around the living and the non-living. Any shift in a system, for example through human interactions and/or impacts, cause shifts in the mauri of immediately related components. As a result, the whole system eventually becomes affected and degraded. All activities and relationships are bound up and governed by principles and ethics and regulated by an elaborate system of tikanga, ritenga or rules.

The process is still used by Māori to guide resource use and management. Therefore, a key outcome for kaitiakitanga is to restore balance back the whole system, to maintain or restore the mauri, and to ensure this balance is maintained between people and the natural and spiritual worlds".

Whakapapa (explained earlier in this paper) is central to notions of soil health as it provides the linkages and inter-connections between people and the natural environment, including organisms and ecosystems. Ancestral stories refer to the *mauri* of the soil and sacred earth which was brought from traditional homelands to NZ by Polynesian ancestors and placed on gardens and at other sacred sites to reaffirm connection and whakapapa (JPS 1913, 1915; Keane 2011a,b).

Māori define soil health in a very holistic way (systems thinking) stressing interconnections and strong links to sustaining life, food production, and human wellbeing. Māori concept models and definitions tend to locate Māori at the centre of ecosystems and regard a healthy soil as one "capable of supporting, maintaining, and enhancing life and wellbeing".

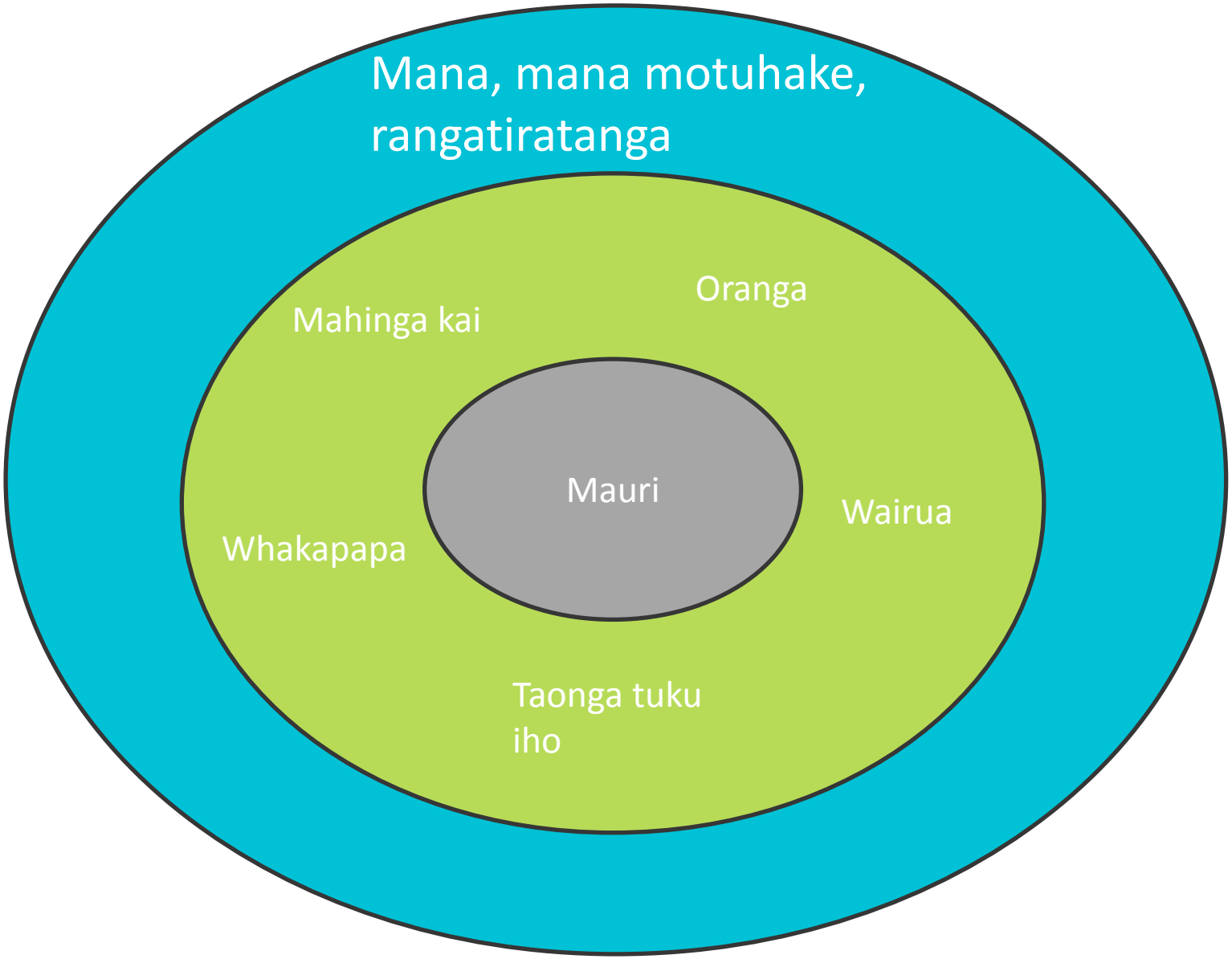


Harmsworth GR, Awatere S 2013. Indigenous Māori knowledge and perspectives of ecosystems.

The following values and principles have emerged as integral to the understanding of soil health from a Māori perspective:

Mana, mana whakahaere/rangatiratanga/ mana motuhake, Mauri, Mahinga kai/Maara kai, Oranga ora, whenua ora, oneone ora, Whakapapa, Wairua, Taonga Tuku Iho.

This provides the foundation for the development of evidence/datasets; finding the data required to establish if these principles are being met) and Māori soil indicators.


Mana, mana motuhake, rangatiratanga
Oranga
Mahinga kai
Mauri
Wairua
Whakapapa
Taonga tuku iho

Māori soil health values and principles

Core values/principles	Values/Principles – Description
Mana, mana whakahaere, rangatiratanga	Rights to manage land, soil, and resources, and exercise mana and kaitiakitanga over resources. Recognises the Treaty of Waitangi, Māori land versus tribal interests, iwi/hapū/whānau to express local through to national rights and interests (e.g. over resources, authority for decision-making, management).
Mauri	Life force, energy, vitality of the soil to sustain/support life and wellbeing. e.g. well-functioning soil ecosystems, full of soil biota, interconnections between physical, chemical, biological components and people.
Mahinga kai	Ability of soil to produce and sustain food for harvest and collection
Oranga ora, whenua ora, oneone ora	Ability of soil to provide and ensure health and wellbeing of people (ko au te whenua, ko au te oneone, ko te whenua/oneone ko au, ngā tangata), in accordance with tikanga and kawa, (e.g. no human waste) and supply healthy food. e.g., with no harmful contaminants, pathogens, pesticides, and free of toxicity. A well-functioning soil free of contaminants and waste in accordance with cultural values.
Whakapapa	Respect for ancestral links or lineage of the soil, connections back to ancestors, origins of Papatūānuku and Ranginui, Whenua, Ātua domains, also denotes family connections to place and between whānau/hapū/iwi.
Wairua	The spiritual domain or dimension. Conveys elements of whenua/soils to spiritual connections which bind the living to the non-living, the heavens to the earth, to give mauri and spiritual health which transcends through to people, food and resources.
Taonga Tuku Iho	Ability to sustain the soil resource for future generations, using concepts like kaitiakitanga and Te Ao Turoa. Intergenerational equity of the soil resource and its ability to provide for future generations. The soil resource is sustained, in as good or if not better condition

Maori soil health datasets/evidence/indicators

Core values/principles	Types of data /evidence/indicators
Mana, mana whakahaere, rangatiratanga	Data/evidence that Māori are making decisions over their whenua, over their ngā oneone; This could be over tribal rohe (e.g. iwi /hapū management plans) or could be on specific land blocks/whenua where they have whakapapa and mana (e.g. kaitiaki, owners, beneficiaries). Decisions for enhanced soil health, using soil management guidelines, plans, and implementation of best practice on Māori land.
Mauri	Data/indicators which demonstrate the soil and people are in a healthy state and are connected, the system is in balance, indicators which show the vitality and energy of the soil resource, or the diminished state of the soil.
Mahinga kai	Data/attributes/indicators of mahinga kai, and that the mahinga kai is healthy and comes from healthy soils.
Oranga ora, whenua ora, oneone ora	Data/indicators of a healthy soil is providing healthy food, and healthy people. That practices for growing food from soil is following tikanga and guidelines for food sovereignty, food safety and food security. e.g., no harmful contaminants, pathogens, pesticides, free of toxicity. A well-functioning soil free of contaminants and waste in accordance with cultural values.
Whakapapa	Data/indicators which show the ancestral links between people and place, people and soils, and confers responsibility to those to manage soils for enhanced soil health and human survival and wellbeing
Wairua	Data/evidence that the wairua is intact, the spiritual health of the people is intact, and provides a connection between the spiritual and the physical, in order to sustain the soil in a healthy state. Binds the soil (like glue) to provide balance between mauri and mana.
Taonga Tuku Iho	Data/indicating a resilient healthy soil, that is able to provide

Maori soil health indicators (examples)

Core values/principles	Soil health indicators
Mana, mana whakahaere, rangatiratanga	No. Iwi management /kaitiaki plans that refer to soils, soil health Land/soil management practices, to improve soils, implemented on Māori land Areal extent of healthy soils on Māori land % areal extent of land-uses/contaminated areas that reduce soil health on Māori land
Mauri	Mauri whenua ora/mauri being enhanced Soil ecosystems/soil biota that indicate well functioning soils (e.g. earthworms, porosity, OM) per (land area) High life supporting capacity, soil capacity/integrity high (land area) % area/tribal area: Strong connection between soils and people (e.g. area of soils used for gardening, cropping, mahinga kai, etc)
Mahinga kai	Mahinga kai areas are assessed as healthy with mauri intact, good-high People/whānau are healthy (proportion)
Oranga ora, whenua ora, oneone ora	Soil health is being maintained, within range, across all key indicators % proportion of food that is healthy and free of contaminants/pathogens/pesticides Human health/wellbeing is good to excellent (proportion of people v total)
Whakapapa	Whakapapa is recorded/transfered and known between people and whenua/soils, No. of wānanga/field studies on whenua/soils The ancestral links between people and place, is known Kaitiakitanga is practiced over natural resources, including soils
Wairua	The spiritual dimension/domain is important to local people Wairua is seen as part of maintaining/strengthening mana and mauri Wairua provides balance in the system, a well-balanced functioning soil ecosystem is achieved (e.g. kaitiakitanga and karakia practiced)
Taonga Tuku Iho	Soil health is maintained in areas for future generations

Maori soil health concepts and definition–*provisional* (Soil health: oneone ora, tangata ora)

"…the capacity of a soil as a living ecosystem to sustain and support all forms of life (to sustain microbes, plants, animals, humans and complex interconnections), through the maintenance of te mauri, to strengthen and enhance whakapapa, taonga tuku iho, mana, oranga, wairua, and whai rawa"

"capable of supporting, maintaining, and enhancing life and wellbeing".

Soil health understood holistically (beliefs, whole ecosystem and interconnections –microbes to people)

Long term view of soil resilience (generational, "resilient soils, resilient people")

"…Te Mana o te Whenua, te mana o te oneone, te mauri o te oneone"

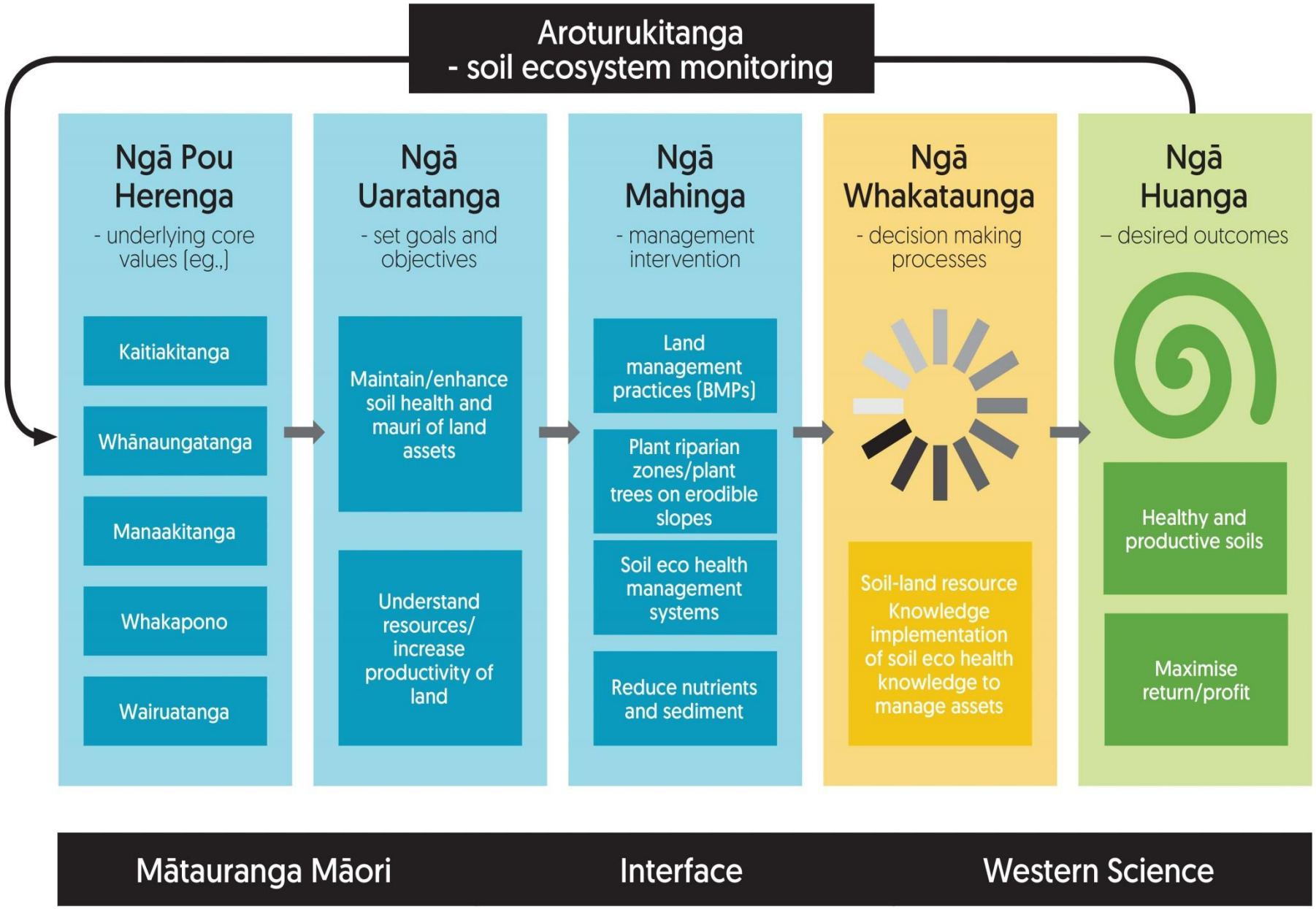
"The mana of the land, the mana of the soil, the mauri of the soil".

Maori soil health concepts and definition–*provisional* (Soil health: oneone ora, tangata ora)

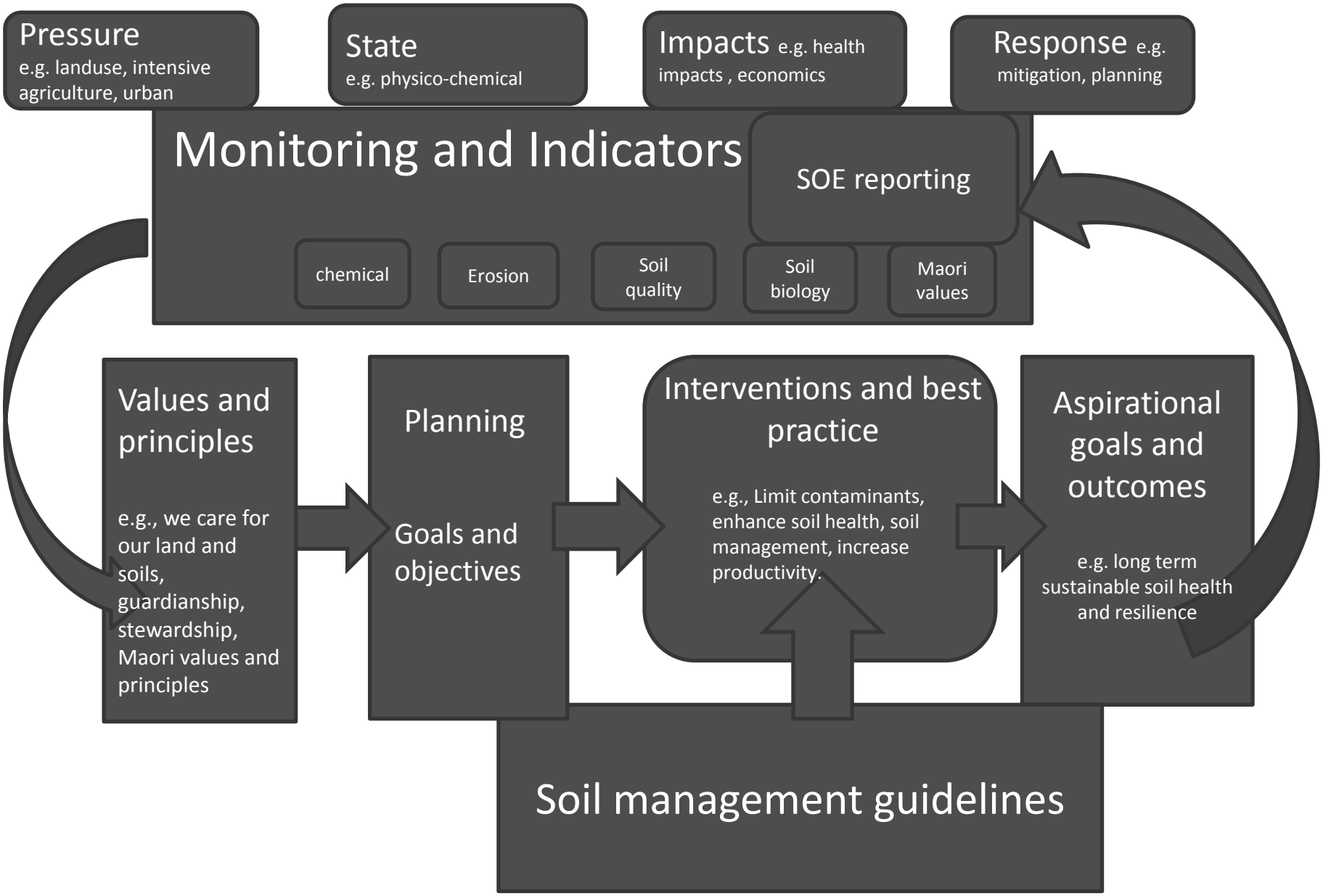
- Mauri (internal essence, life force, assessment, local knowledge) e.g. a healthy functioning soil fit for purpose and sustaining life, health, and prosperity, capacity of a soil to function as a living system to sustain mauri
- Mana (authority to manage and make decisions) also can imply the mana of a soil (as a living entity) – food sovereignty e.g. ability to make decisions over ones land, soil management guidelines and best practice
- Mahinga kai and Maara kai (the ability of the soil to provide sustenance, food sovereignty, and prosperity) e.g. area of soils that sustain gardening/organics
- Oranga, ora (measure of food safety and food health from soil) e.g. a soil free from pesticides and contaminants, meets food safety standards

Table 1: Complementary soil assessment/monitoring approaches

Kaupapa Māori soil assessments/indicators	Farm, community–technical & non-technical assessments	Science based – including professional scientific, technical assessments, and science based (statistical) sampling strategies
Kaupapa Māori based **Mātauranga Māori knowledge based** **Based on Māori concepts and values** **Examples:** **Hua parakore (Maori organics)** **Kaitiaki assessments (pastoral, cropping, gardening, etc)** **Farm KPIs** **Customary environmental indicators e.g. mahinga kai** **Cultural impact assessments** **Iwi/hapū/marae monitoring of contaminated sites** **Require in-depth Māori knowledge and understanding of particular environments and issues. Understanding of Māori values, goals, and aspirations.** **Kaupapa Māori approaches can include science and technical assessments.** **Examples:** • **Māori concepts, principles, and values** • **Kaupapa or mātauranga Māori based assessments and indicators** • **Traditional stories, narratives, gardening, maara kai, mahinga kai** • **Soil management guidelines, best practice**	Examples: • Can be subjective • Visual soil assessment (VSA) • Farm assessment • Farm indicators • Community based indicators (e.g. collectives) Can be subjective and practically based. Cost effective, relatively simple and short duration assessments linked to land management, soil management, farm operations, cropping, orchards, market gardens, hill country, etc. • Farmer, grower, orchardist, industry • Community values • Technical and non-technical assessments • School assessment programmes (soils and gardens) VSA pastoral, soil management, hill country, Indicators: • Soil structure and consistence • Soil porosity • Soil colour • Earthworm counts • Compaction–tillage pan, clod development • Soil erosion • Organic matter • Plant indicators	Scientific soil quality and soil health indicators: e.g., objective, measure 'soil quality' or 'soil health target range' Example indicators measured Organic reserves • Total carbon • Total nitrogen • Mineralisable nitrogen Fertility • Olsen phosphorus Acidity • pH Physical status • Bulk density • Macroporosity Trace elements Contaminated soils Use science based sampling strategy Laboratory analysis Require higher levels of technical input and skill, robust sampling strategies, analysis and interpretation, can be expensive and time-consuming.


Aroturukitanga
- soil ecosystem monitoring
Ngā Pou Herenga
- underlying core values (eg.,)
Kaitiakitanga
Whānaungatanga
Manaakitanga
Whakapono
Wairuatanga
Ngā Uaratanga
- set goals and objectives
Maintain/enhance soil health and mauri of land assets
Understand resources/ increase productivity of land
Ngā Mahinga
- management intervention
Land management practices (BMPs)
Plant riparian zones/plant trees on erodible slopes
Soil eco health management systems
Reduce nutrients and sediment
Ngā Whakataunga
- decision making processes
Soil-land resource Knowledge implementation of soil eco health knowledge to manage assets
Ngā Huanga
– desired outcomes
Healthy and productive soils
Maximise return/profit
Mātauranga Māori
Interface
Western Science

An integrated soil health framework



Main findings to date

- Traditional and historic knowledge and concepts very important for defining soil health – **strong values/principles component**
- Whakapapa, mana, wairua, mauri and other values integral
- An understanding of Māori/human wellbeing and health concepts and models has been fundamental

- Traditional knowledge around soils, uses, practices and food production
- Strong links to food production and kai, sustains ecosystems, life, health and wellbeing (mauri whenua ora)
- Healthy food based on healthy soils is essential

Main findings to date (cont)

- High level of interest in assessment approaches and indicators – **using mātauranga Māori, kaupapa Māori, technical, and science**
- Māori want to develop soil management guidelines and practices to fulfil kaitiakitanga responsibilities and aspirations
- Māori see soil management in the long term, a resilient and healthy soil builds resilient people and communities